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Interregional migration in Indonesia

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Introduction



1.1. Background

Migration is one of the main topics in population studies, as it plays an important role in altering the distribution of population. Migration contributes substantially to the trends towards demographic concentration and population redistribution in the developing world, and has fuelled the growth of large cities in many of these countries, including in Indonesia (Hogan & Pinto da Cunha, 2001). Alatas (1993) calculated the increase in population mobility in Indonesia during the 1971-1990 period, and found that while just 4.94 percent of Indonesians lived outside of the province where they were born in 1971, this share had risen to 8.25 percent by 1990. The analysis also showed that the percentage of recent migrants — individuals whose province of residence at the time of the enumeration differed from their province of residence five years prior to the enumeration — increased from 2.97 percent in 1971 to 3.32 percent in 1990. These patterns suggest that there has been an increase in population mobility in Indonesia, and that mobility has become an important component of Indonesia's population dynamics in recent decades.

According to De Jong and Gardner (1981), migration is becoming an increasingly significant issue for a number of reasons. *First*, the rate of natural increase of populations is slowing down. *Second*, both the scope and the magnitude of urbanisation is increasing. *Third*, the policy issues related to migration in developing countries are attracting increasing attention. *Fourth*, the trend towards population deconcentration in the form of metropolitan-to-non-metropolitan migration is accelerating, particularly in the developed countries.

The first of these reasons clearly applies to the case of Indonesia, as the rate of natural population growth in the country has indeed been slowing down. The population growth rate fluctuated from 2.1 percent per year during the 1950-1961 period, when the Indonesian political situation began to stabilise after the war; to 2.3 percent per year during the 1971-1980 period. The annual population growth rate then declined to 2.0 percent in 1980-1990, and decreased further to 1.4 percent in 1990-2000, but then increased slightly to 1.5 percent in 2000-2010 (BPS, 2011c). The slowdown of natural population growth also occurred at the regional level. Therefore, internal migration helps to explain why some regions of Indonesia have been growing faster than others.

The second reason is also relevant in the Indonesian context, as the urbanisation rate in the country has increased sharply in recent decades. While the urbanisation rate (the proportion of the population living in urban areas) was 14.8 percent in 1961, it had reached 49.8 percent by the time of the 2010 census.

Furthermore, according to Rogers et al. (2004), Indonesia has entered Phase 4 of the mobility transition (late transition), which is characterised by mass migration from rural to urban areas, primarily to the largest cities. The increase in the urbanisation rate has mainly occurred in Java, where it jumped 9.6 percentage points in a single decade: i.e., from 48.9 percent in 2000 to 58.5 percent in 2010. The sharp rise in the number of people living in urban areas has been caused not just by demographic factors (natural increase and migration from rural to urban), but also by area reclassification (the transformation of rural areas into urban areas). This urbanisation trend is thus accelerating the formation of urban agglomerations.

An urban agglomeration is an urbanised core region that consists of several adjacent cities or megacities and their surrounding developed suburbs (World Bank, 2012). An example is the Jabodetabek area (consisting of Jakarta, Bogor, Depok, Tangerang, and Bekasi), which is home to about 28 million people. These cities currently face serious challenges, including high rates of poverty and unemployment; heavy pollution; and inadequate or non-existent clean water, sewage, and waste disposal systems (Alatas, 1993). The study of migration can help us gain a better understanding of how we can design and implement policies aimed at alleviating not just the unequal distribution of the population, but the social inequalities that result from this distribution pattern.

The third reason given by De Jong and Gardner for why migration is becoming an increasingly significant issue is that policy issues related to migration in the developing countries are receiving more attention now than in the past. Since the Dutch colonial era, the population of Indonesia has been redistributed through both voluntary and involuntary migration. Involuntary (forced) migration occurred, for example, when the Dutch government moved a large number of labourers from Java Island to the surrounding islands. Moreover, during World War II, around 200,000 inhabitants of Java were employed as forced labour in Southeast Asia, and as many as six million people were internally displaced during the revolution. There were also several waves of voluntary migration. For example, large numbers of Indonesians migrated to the trading port of Malacca (in Malaysia) to find work. In the pre-independence period (1905-1941), a Dutch population redistribution program called “*kolonisasi*” attempted to redistribute the population, supposedly in order to alleviate increasing poverty in the rural parts of Java. The fundamental justification for *kolonisasi* was that there were “too many people” in “Inner Indonesia”, particularly in Java (Otten, 1986. See Hugo et al. 1987 for more detailed overview). This *kolonisasi* program, which is generally seen as the predecessor of transmigration (*transmigrasi*), successfully relocated hundreds of thousands of people from Java

to the outer islands of *Nusantara* (the archipelago). However, subsequent waves of return migration to Java largely reversed the effects of this program, and have led to rapid urbanisation (UN-ESCAP, 1981).

The fourth reason cited by De Jong and Gardner for why migration has become an increasingly significant issue – i.e., the increasing trend towards population deconcentration through metropolitan-to-non-metropolitan migration, particularly in the developed countries – is difficult to assess in the Indonesian context given the lack of research on internal migration trends in Indonesia. In one of the few such studies that exist, Alatas (1993) examined the macro patterns of internal migration in Indonesia in the 1971-1990 period, and found some indications of deconcentration for Jakarta. However, the study only covered inter-provincial migration in the 1971-1990 period, and was therefore unable to capture the deconcentration processes for other metropolitan regions. Thus, it is necessary to assess inter-regional migration in Indonesia while distinguishing between metropolitan and non-metropolitan areas.

To date, research on migration flows between metropolitan and non-metropolitan areas or between metropolitan areas in Indonesia remains rare. This thesis aims to fill this research gap by analysing inter-regional migration in Indonesia using not just a different approach to area classification than the categorisation approach typically employed in previous research (metropolitan and non-metropolitan areas), but also different methods of analysis (macro, micro, and micro-macro approaches). The thesis addresses four themes: migration and population redistribution; a macro approach to migration; a micro approach to migration; and an agent-based modelling approach to migration.

1.2. Previous research

Migration and population redistribution

A number of studies that examined the relationship between regional development and migration (De Haas, 2010; Fan, 2005; Skeldon, 1997; Zelinsky, 1971). Zelinsky (1971) used the mobility transition model to track the transitions that have been occurring in both the rate and the scale of migration as society changes over time. In this model, migration is seen as being integral to the economic and social changes that have been unfolding throughout the modernisation process (Boyle et al., 1998; Hagen-Zanker, 2008; Skeldon, 1997). This so-called “mobility transition” encompasses the migration patterns that can be observed across five distinct stages: pre-modern traditional society, early transitional society, late transitional society,

advanced society, and future super-advanced society. According to Rogers et al. (2004), Indonesia has entered the fourth phase of Zelinsky's mobility transition, which is characterised by mass rural-urban migration towards the largest cities. This claim has been strengthened by evidence of widespread non-permanent mobility in Indonesia since the 1970s (Hugo, 1982).

Zelinsky's theory only addresses migration phases, and does not take into account the impact these phases have on population distribution. Long's (1985) theory of migration offers a more comprehensive approach to exploring the relationship between the stage of development and the degree of population concentration, while assuming that migration plays an important role in population redistribution. According to Long, population concentrates in urban centres during the early stages of development because these centres fulfil the need for social and economic interaction; and population deconcentrates during the later stages of development because transportation and communication allow for interaction at longer distances. Long (1985) identified six phases of population redistribution trends: initial urbanisation, frontier settlement, traditional urbanisation, over-urbanisation, sub-urbanisation, and metropolitan-to-non-metropolitan migration. When this theory is applied to the case of Indonesia, it is clear that Indonesia has passed through the initial urbanisation and frontier settlement phases of population redistribution. An example of how these phases played out in the Indonesian context is the movement of people from Java to Lampung on Sumatera as a result of the Dutch resettlement program known as colonisation (*kolonisasi*) starting in 1905. The architects of this program assumed that the Javanese would have sufficient skills to clear the jungle and develop irrigated rice fields (Hugo et al., 1987; Nitisastro, 1970).

Although there are some studies on inter-regional migration in Indonesia (see, for example, Alatas, 1993; Chotib, 1999; Darmawan & Chotib, 2007; Firman, 1994; Rogers et al., 2004), there is little research on migration flows between metropolitan and non-metropolitan areas or inter-metropolitan areas, particularly using a population redistribution framework. Alatas (1993) studied the inter-province migration pattern in Indonesia between 1971 and 1990. She discovered that the rate of population mobility in Indonesia increased during this period, from 4.94 percent in 1971 to 8.25 percent in 1990. Firman (1994) examined the inter-provincial migration patterns in Indonesia for the 1980-1990 period, and attributed the patterns, volumes, and directions of migration to regional developments. He concluded that the inter-provincial migration patterns in the 1980-1990 period were still "Java-centric", with Java island being the main origin and destination for migration.

Macro approaches to the study of migration

Explanations for migration have been formulated at both the macro and the micro levels. Macro-level analyses focus on aggregate migration patterns, and seek explain these patterns in aggregate terms (Hagen-Zanker, 2008).

The macro approach to migration, which is rooted in neoclassical economics, relates migration to social-economic and physical environments, such as wage rates, unemployment, and climate (Cadwallader, 1989). This approach asserts that migration is an element of economic development; i.e., that it is a response to geographical differences in the supply of and the demand for labour, mostly between the rural traditional agriculture sector and the urban modern manufacturing sector (Hagen-Zanker, 2008). Macro theories of migration thus explain broad patterns of movement between geographic units and population aggregates.

Alatas (1993) and Firman (1994) studied the inter-province migration patterns in Indonesia. Alatas (1993) analysed these migration patterns between 1971 and 1990, and concluded that Jakarta and West Java were the main migration destinations. In line with Alatas (1993), Firman (1994) used the term “Java-centric” in characterising the migration patterns in Indonesia between 1980 and 1990. Firman (1994) has attributed these Java-centric patterns to the economic domination of Java, particularly in the manufacturing and services sectors. These two studies however, lack the explanations regarding the effects of economic variables on migration.

Darmawan and Chotib (2007) and Van Lottum and Marks (2012) are inter-regional migration studies that used the economic approach to explain inter-province migration in Indonesia. Darmawan and Chotib (2007) applied modified gravity models that incorporated three economic variables: gross domestic product (GDP), regional minimum wage, and unemployment rate. Their investigation of the inter-provincial migration patterns in the 2000-2005 period found that migration was directed towards the regions with higher GDP, lower unemployment rates, and lower regional minimum wages.

Van Lottum and Marks (2012) studied the inter-provincial migration flows between 1930 and 2000. They applied a modified gravity model that relied on six variables to explain migration: population size, GDP, distance, contiguity, transmigration indicator, and urban primacy indicator. Unlike Darmawan and Chotib (2007), who focused on recent migration trends, Van Lottum and Marks (2012) used data on lifetime migration flows derived from various censuses and surveys conducted between 1930 and 2000. Van Lottum and Marks (2012) concluded that economic variables explain a large share of the migration flows in Indonesia. They also found that Jakarta, as an urban primacy, strongly affected the directions and the sizes of migration flows.

The studies mentioned above explained inter-province migration in Indonesia using macro approaches, with and without economic variables. With the exception of Van Lottum and Mark (2012), these studies devoted little attention to the issue of migration flows between metropolitan and non-metropolitan areas or inter-metropolitan areas, particularly using a population redistribution framework.

Migration and the life course

In contrast to the macro approach, the micro approach focuses on individual migration decisions, and is concerned with how people choose between alternatives. Thus, this approach borrows from the theories of choice behaviour developed by psychologists (Cadwallader, 1989). Rather than emphasising the numerical count of events, the micro approach takes into account a wide range of economic and non-economic factors that affect the decision of an individual – who is seen as part of a family/household – about whether to move or to stay. In other words, micro-level analyses focus on the individual and/or the family as the unit of analysis in describing and explaining migration behaviour (De Jong & Gardner, 1981).

Mulder and Hooimeijer (1999) identified a number of opportunities and constraints in the macro context, including in the economic and the political contexts. Opportunities drive migration, whereas constraints hinder people from moving. Opportunities and constraints also exist at the micro level, as the circumstances of an individual's life play an important role in migration processes. An individual's resources can facilitate migration, while restrictions can prevent the person from moving (De Groot et al., 2011; Mulder & Hooimeijer, 1999).

The life course theoretical perspective can be used to help explain migration phenomena in Indonesia, as certain major life events in an individual's life course can have strong triggering effects on migration. A person might decide to migrate for a number of reasons, such as to get a better education, to form a family, or to find a job. Furthermore, according to Mulder (1993), events and situations in people's life courses not only affect migration in general, but also cause them to engage in forms of migration that vary in terms of distance, direction, and destination choice. Thus, different types of people in different life course stages will respond in different ways to the various types of migration stimuli (Feliciano, 2005; Rahman, 1991). It therefore appears that migration is not a random event in an individual's life course, but is rather selective on certain characteristics. Age, gender, education, participation in the labour market, and marital status are among the key individual characteristics that have been shown to influence migration (see, for example, Fischer & Malmberg, 2001; and Greenwood, 1985).

Age has been used as a predictor of and a proxy for the life course stage. For migration events, Rogers and Castro (1981) constructed an age profile of migrants that showed an age-migration dependency. According to this so-called “age migration schedule”, the typical migrant is young, and the propensity to migrate tends to decline steadily with increasing age; although in some contexts it can rise again around the age of retirement, or at the ages at which people tend to need care. This schedule thus reflects the age structure of life course transitions, which is also highly likely to be influenced by the socioeconomic context (Bernard et al., 2014; Clark, 2013; Fischer & Malmberg, 2001; Rogers & Castro 1981; Rogers et al., 2004). Wajdi (2010) constructed an age profile of inter-island migration in Indonesia for the 1995-2005 period. He found that the people who were the most mobile were those aged 23-54, followed by those aged 0-14, those aged 15-22, and those aged 55 and older. Wajdi (2010) also showed that the most mobile age group migrated primarily for economic, family-related, and education-related reasons. It is therefore clear that migration patterns differ with age and change with each life course transition (Warnes, 1992).

As life courses are differentiated by gender, we would expect to find that women and men have different patterns of migration. The evidence for Indonesia suggests that gender differences in the likelihood of migration are based on gender roles; i.e., women are traditionally expected to take on kin-based and domestic roles (see, for example, Ananta et al., 2001); whereas men are generally freed from domestic roles, and are instead expected to explore the world (*merantau*) (Naim, 1974: pp. 31, 41, 268, 324).

Based on the concepts of “resources” versus “restrictions” proposed by Mulder and Hooimeijer (1999), it may be assumed that education, participation in the labour market, and marital status are elements of an individual’s resources or restrictions. A desire to pursue higher education may trigger migration. Moreover, individuals with higher educational attainment are likely to find it easier to move over longer distances (Kodrzycki, 2001) than those with lower education attainment. An actual or an anticipated change in job status can also be a motivation for migration (De Groot et al., 2011; Stockdale & Catney, 2014), whereas individuals who are unemployed or outside of the labour market are less likely to migrate (Basker, 2003). People who intend to start a family are likely to migrate, but may be restricted from moving by family ties once they are married (see for example Mincer, 1978).

Using inter-censal survey data for 2005, Malamassam (2016) examined the migration behaviour of Indonesians aged 15 to 24. She concluded that the migration preferences of these young people were determined by their individual characteristics and by the development levels in both the area of origin and the area of destination.

Her analysis also showed that education was an important determinant of youth migration: i.e., having more education increased an individual's resources for migrating, and was associated with a greater tendency to migrate to a big city.

Complexity in migration studies

The migration flow from area i to area j is the aggregate of individual migration behaviour from area i to area j . However, migration is a complex human behaviour involving a range of micro as well as macro factors. Studying human behaviour, including migration, therefore entails dealing with a range of complex issues that arise from interactions between individuals, and from individuals' interactions with their contextual environment (Jager & Janssen, 2003). The interactions between individuals at the micro level may cause changes at the macro level, which could in turn affect the decisions of individuals. For example, if a number of people migrate from region i to region j because region j has a lower population density than region i , the population density in region j will increase. In turn, people in region j may start to consider moving to region k because region k has a lower population density than region j . This so-called feedback mechanism may be difficult to explain or to capture using statistical models, partly because of the complexity of the phenomenon, and partly because of the limited availability of empirical data (Billari et al., 2003; Jager & Janssen, 2003). As Billari et al. (2003) argued, it is possible to test multilevel theories of demographic behaviour using a well-developed multilevel statistical approach as long as sufficient data are available. However, the data needed for such analyses may not be available in all cases.

Recent advances in simulation techniques and in information technology (hardware as well as in software) could make it easier for researchers to solve these problems. For example, researchers could build a virtual laboratory that allows them to observe real-life situations, including phenomena that typically evolve over a long periods of time in a given setting. In the social sciences, and in demography in particular, simulation models have been widely used to describe individual behaviour (Billari et al., 2003; Jager & Janssen, 2003). These models are often seen as tools for developing theories of human behaviour that seek to explain rather than predict behaviour. As models of this kind are based on individual agents, they are known as agent-based modelling (ABM) (Billari et al., 2003).

One aim of ABM is to identify aggregate patterns based on micro-founded behaviour (the micro-to-macro or bottom-up approach). In other words, the goal is to assess the effects of the agents' interactions with other agents (at the micro level), and with their environment, on the whole system (at the macro level) (Railsback & Grim, 2011).

In research on migration, ABM has been applied to simulate migration responses to different environmental stimuli. Cai and Oppenheimer (2013), Hassani-Mahmooei and Paris (2012), Kniveton et al. (2012), Smith (2014), and Ziervogel et al. (2005) are among the scholars who have studied migration responses to climate change. To simulate state-level migration patterns from East to West Germany, Heiland (2003) employed a conventional push-and-pull framework in which moving costs and job search costs were seen as determinants of migration. The agents in Heiland's model were assumed to be heterogeneous, and to differ with respect to their location and other characteristics. The results of this simulation indicated that the heterogeneity of the agents was crucial to explaining the patterns observed (Heiland, 2003). To date, however, no agent-based models and simulations have been applied to migration in Indonesia.

Billari et al. (2003) listed seven advantages of using agent-based modelling (for the field of demography: agent-based computational demography/ABCD) in addition to other demographic methods. Compared to forms of mathematical modelling, agent-based modelling makes it relatively easy to introduce heterogeneous agents and include feedback mechanisms. It is also possible to use this approach to build bottom-up/micro-to-macro models; that is, to integrate micro-based behavioural theories with macro-level outcomes. Another advantage of ABM is that it enables researchers to construct models to study issues for which there is no explicit analytical solution available, such as non-linear models of social interaction. Yet another advantage of agent-based modelling over mathematical models is that it can be used to create an artificial society in a computational laboratory with a macroscopic pattern based on observed microscopic behaviour (Billari et al., 2003; Jager & Janssen, 2003).

1.3. Scope of the study

Research questions

The first of the empirical chapters of this thesis provides a descriptive analysis of inter-regional migration flows in Indonesia (Chapter 2). The subsequent empirical chapters present analyses that attempt to explain migration using a macro approach (Chapter 3), a micro approach (Chapter 4), and, finally, an agent-based modelling approach accompanied by simulation (Chapter 5). It is important to note that unlike most previous studies that have used these approaches, this research was conducted in the context of a developing country; namely, Indonesia. The main contribution of this research to the migration literature lies in its focus on this developing country.

Thus, the main research question addressed in this thesis is as follows:

What are the dynamics of inter-regional migration in Indonesia in the specific settings of metropolitan and non-metropolitan areas?

In order to answer this general research question, several quantitative approaches are utilised and presented in four chapters. The analyses presented in Chapter 2 aim to contribute to our knowledge of inter-regional migration flows in Indonesia in a population redistribution framework. The research questions for Chapter 2 are as follows:

- a. *Where do the main flows of migrants in Indonesia come from and what are their destinations?*
- b. *What phase of population redistribution is Indonesia currently in based on observed migration patterns?*
- c. *To what extent can patterns of regional concentration of migration flows be detected based on a set of origin-destination-regional flows?*

For the case of Indonesia, the association between economic development and migration flows has seldom been investigated. Moreover, only a few existing studies have used an explanatory modelling approach to investigating migration flows. Therefore, in Chapter 3, an exploration of the macro determinants of interregional migration in Indonesia is presented. More specifically, the substantive aim is to test Long's hypothesis that during the early stages of development, economic development has a positive relationship with population concentration. This chapter also examines the impact of several determinants of migration that have rarely been considered for Indonesia: namely, the percentage of agriculture workers, the percentage of highly educated workers, contiguity between regions, and migrant stock. The research questions are as follows:

- d. *To what extent are migration flows in Indonesia directed towards the more developed regions?*
- e. *To what extent do macro determinants explain the interregional migration flows in Indonesia?*

Taking the individual characteristics of potential migrants into account is crucial to understanding migration. However, research that explains how individual characteristics are related to particular types of movement is still lacking for Indonesia. To fill this research gap, Chapter 4 presents an exploration of the relationship between individual characteristics and different types of migration based on origin and destination. The main contribution of the approach used in this chapter is that it

distinguishes between types of migration in Indonesia. The first analysis focuses on migration from Jakarta to other metropolitan areas within commuting distance, to other metropolitan areas farther away, and to non-metropolitan areas. The second analysis focuses on migration from other metropolitan areas to Jakarta, to other metropolitan areas, and to non-metropolitan areas. The third analysis focuses on migration from non-metropolitan areas to Jakarta, to other metropolitan areas, and to non-metropolitan areas.

Migration is strongly related to events and stages of the life course. It is often argued that migration is a mechanism for gaining access to better educational and job opportunities and to a better living environment, and that the specific characteristics of individuals tend to be associated with specific types of migration. Therefore, in Chapter 4 the life course approach is used to explore the effects of specific life course factors, such as age, education, labour market participation, and family formation, on inter-regional migration in Indonesia. The research question is as follows:

- f. *To what extent does the likelihood of undertaking certain types of migration vary by an individual's position in the labour market and in the family life course?*

Chapters 2, 3, and 4 refer to empirical models of inter-regional migration in Indonesia. These models all have the same drawback: they are unable to analyse interactions between individuals in conjunction with individuals' responses to contextual change. This is a problem because the evolving spatial distribution of the population is complex, dynamic, and nonlinear (Wu et al. 2010). Moreover, predictions of migration flows could be improved by taking into consideration not just macro factors, but also individual responses to the environment. Since the dynamics of inter-regional migration in Indonesia are non-linear, projecting the future pattern using a simple extrapolation model will likely result in a linear pattern. This chapter presents a rare bottom-up approach for explaining and projecting migration patterns in Indonesia. Utilising an agent-based modelling approach, the research questions are as follows:

- g. *How are inter-regional migration patterns in Indonesia likely to develop, and what are the likely consequences of these developments for the regional population dynamics based on the recent historical trends in inter-regional migration?*
- h. *How are these patterns likely to differ according to different threshold of population density?*

Data and methods

Three main datasets are used in this thesis: Population Census 2000 (PC2000), Intercensal Survey 2005 (SUPAS 2005), and Population Census 2010 (PC2010). Although some studies (see, for example, Alatas, 1993) have shown that SUPAS data may underestimate the volume of migration susceptible to sampling errors, the use of SUPAS data, along with data from the population census 2000 and 2010 population censuses, allows for a more detailed analysis of migration during the 2000-2010 period than would be possible using census data only. SUPAS 2005 is a national survey designed to facilitate estimation up to the district level (415 districts), and to provide demographic data that complement the census data.

Population censuses (PC2000 and PC2010) are complete enumerations of the whole population in Indonesia. PC2000¹ (see Appendix 1.1. for the questionnaire) consists of 201,134,187 records collected from 51,019,972 households who resided in 42,569,097 physical buildings (*bangunan fisik*) situated in 485,507 census blocks in 64,914 villages categorised under 4007 sub-districts in 340 districts in 30 provinces. PC2000 contained 15 questions, including a question on the place of residence five years prior to the census date that was used to distinguish migrants from non-migrants.

PC2010² (see Appendix 1.2. for the questionnaire) consists of 237,641,326 records collected from 61,164,444 households in 724,447 census blocks in 77,084 villages categorised under 6653 sub-districts in 497 districts in 33 provinces. PC2010 contained 21 individual questions, among which eight were related to mortality and 12 were related to housing.

SUPAS2005³ (see Appendix 1.3. for the questionnaire) consists of 1,090,892 records collected from around 250,000 households in 33 provinces. SUPAS2005 contained 94 individual questions, 14 reports on vital events, and 12 questions on housing characteristics.

For the analyses, we have divided Indonesia into 13 administrative regions consisting of metropolitan and non-metropolitan areas. The metropolitan areas are defined using Indonesia's Government Regulation no. 26 of 2008 (pp. 69-80), which does not cover the whole country. The regions are therefore based on both Government Regulation no. 26 (2008) and on data on metropolitan agglomeration size published by the World Bank (2012). The regions consist of several administrative areas below the provincial level; namely, districts (*kabupaten*) and municipalities (*kota*). The 13 regions used in the analyses are listed in Table 1.1., and their locations are shown in Figures 1.1. and 1.2.

¹ <https://sirusa.bps.go.id/sirusa/index.php/kuesioner/54>

² <https://sirusa.bps.go.id/sirusa/index.php/kuesioner/93>

³ <https://sirusa.bps.go.id/sirusa/index.php/dasar/pdf?kd=2&th=2005>

Following Jones and Mamas (1996, pp. 54-55), we distinguish between Jakarta and the surrounding Bodetabek region, because Jakarta is much more urbanised than Bodetabek. In general, demographers define migration as a permanent movement across certain administrative boundaries. For the purpose of this study the term “migration” is used to refer to a transition from one place of residence to another. The transition is measured by comparing the current and the previous residence across an observation interval of five years.

TABLE 1.1. Summary information on the division of Indonesia into 13 regions

Name of Region	Description
1. Jakarta	Jakarta—the Special Capital Region of Jakarta/DKI Jakarta—is Indonesia’s megacity in terms of both population size and economic dominance. In 2005, Jakarta was the world’s 11th largest city, one of 16 megacities in developing countries, and of one of 21 megacities in the world (Spreitzhofer, 2005; World Bank, 2012). Jakarta consists of one district, Kepulauan Seribu; and five municipalities: Jakarta Selatan, Jakarta Timur, Jakarta Pusat, Jakarta Barat, and Jakarta Utara.
2. Bodetabek	This area surrounds Jakarta, and consists of three districts: Bogor, Bekasi, and Tangerang; and four municipalities: Kota Bogor, Kota Bekasi, Kota Depok, and Kota Tangerang. This area is also considered to be part of the Jakarta metropolitan area, or of Jabodetabek.
3. Bandung Raya	This metropolitan area is located in the West Java province, and consists of two districts: Bandung and Bandung Barat; and two municipalities: Kota Bandung and Kota Cimahi.
4. Rest of West Java and Banten (RoWJB)	This region consists of the areas in the West Java and the Banten provinces excluding Bodetabek and Bandung Raya.
5. Kedungsepur	This metropolitan area is located in the Central Java province, and consists of four districts: Grobogan, Demak, Semarang, and Kendal; and two municipalities: Kota Salatiga and Kota Semarang.

Name of Region	Description
6. Rest of Central Java and Yogyakarta (RoC-JY)	This region includes areas in the Central Java and the Yogyakarta provinces, except those in Kedungsepur. Yogyakarta is not seen as a single metropolitan area because most of people living in the province work in the agricultural sector (Handiyatmo, 2009; Sahara, 2010).
7. Gerbangkertosusila	This metropolitan area is located in the East Java province, and consists of five districts: Sidoarjo, Mojokerto, Lamongan, Gresik, and Bangkalan; and two municipalities: Kota Mojokerto and Kota Surabaya.
8. Rest of East Java (RoEJ)	This region consists of areas in the East Java province, excluding the Gerbangkertosusila metropolitan area.
9. Mebidangro	This metropolitan area is located in the northern part of Sumatera island, and consists of two districts: Karo and Deli Serdang; and two municipalities: Kota Medan and Kota Binjai.
10. Rest of Sumatera (RoS)	This region consists of areas in the rest of Sumatera excluding the Mebidangro metropolitan area.
11. Kalimantan	This region is the Indonesian part of Borneo, and consists of five provinces.
12. Sulawesi	This island of consists of six provinces.
13. Rest of Indonesia (RoI)	This region consists of seven provinces: Bali, West Nusa Tenggara, East Nusa Tenggara, Maluku, North Maluku, Papua, and West Papua.

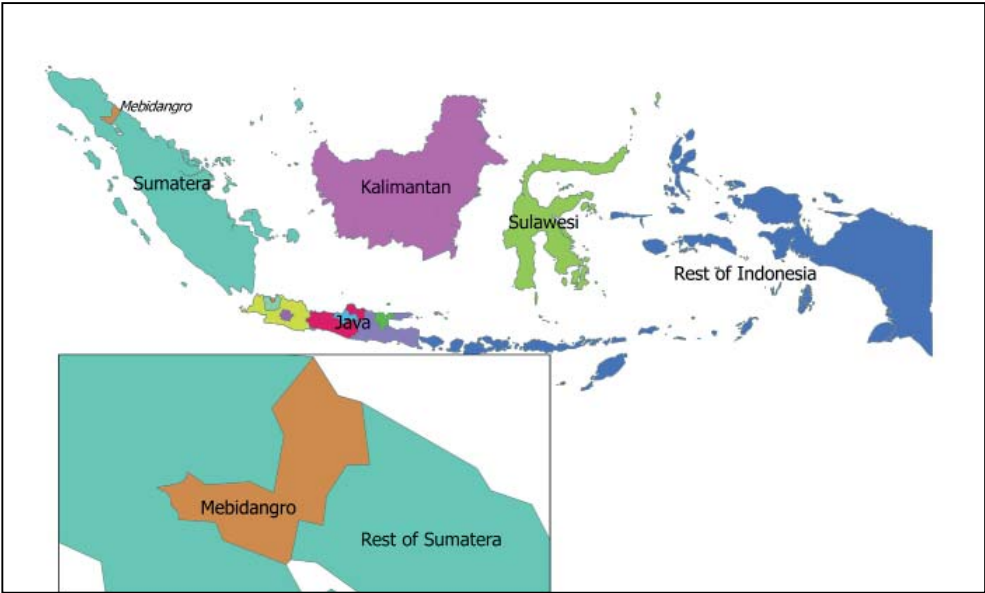


FIGURE 1.1. Map of Indonesia, showing the regions used in analysis, with an inset showing a map of Mebidangro

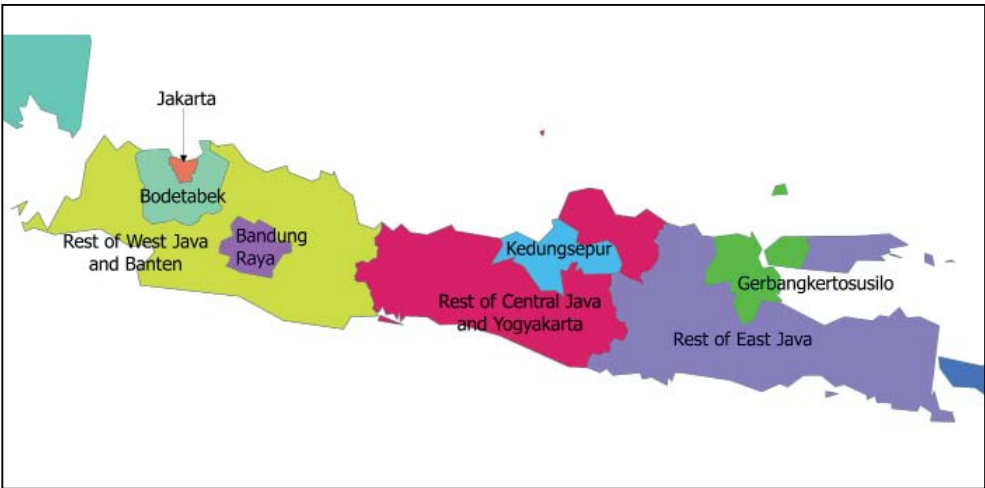


FIGURE 1.2. Map of Java showing the regions used in the analysis

In each chapter in this study, different statistical methods are employed. In the first part of the analysis in Chapter 2, flow maps produced by JFlowMap are presented. JFlowMap is a graphical tool that offers various visualisation techniques for producing and analysing flow maps developed by Boyandin et al. (2010). The second part of the analysis in Chapter 2 is conducted by applying two log-linear models to describe the level and the distribution of migration. The third part of the analysis in Chapter 2 compares the degree to which the sources of in-migration and the destinations of out-migration are spatially focused using the Gini index.

In Chapter 3, one basic and two extended gravity models of migration are estimated using Poisson regression that employs the Poisson pseudo-maximum likelihood (PPML) estimator proposed by Silva and Tenreyro (2006).

In Chapter 4, multinomial logistic regression models are used to analyse the factors that differentiate various types of migrants from stayers. Specifically, three multinomial logit models are estimated that identify types of migrants according to their origin and their destination (Jakarta, other metropolitan areas, and non-metropolitan areas).

In Chapter 5, an agent-based model (ABM) of inter-regional migration that simulates the future migration patterns of the population of Indonesia is presented. Agents are used to simulate individuals who live in a geographic area, and who choose their migration destination based on the attractiveness of the destination.

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